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Agenda item: AH 08

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Title: CR 25.215-023rev1: Compressed mode by puncturing issues (revision)

Document for: Discussion and decision

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1. Introduction

In this paper, several issues related to compressed mode by puncturing will be discussed. Since it was agreed in RAN#6 meeting that puncturing method for creating transmission gaps in downlink will also be included into release99 specifications, following issues should be decided in order to get it sufficiently specified:

- Is the puncturing done per TTI or per radio frame basis

- Is there a need to modify the DeltaSIR parameter that is presently defined to be signaled to the UE to be used for outer loop target in the compressed frame [3]. E.g. is there a need for more than one DeltaSIR parameter. And how these parameters should be used with compressed mode.

- Are there some restrictions how the compressed mode pattern parameters are defined for compressed mode with puncturing for GSM FCCH/SCH search when timing is not known.

- Are there some restrictions how the compressed mode pattern parameters are defined for compressed mode with puncturing for FDD-FDD interfrequency handover

- Timing and simultaneous patterns

All these issues are dealt in this paper, and a proposal is given for each item.

2. Compressed mode by puncturing, per TTI or radio frame basis

A simple example is used for illustrating which method has better performance: a) puncturing done per radio frame or b) puncturing done per TTI. Table 1 gives the parameters used:

TTI lengths	TrCH1: TTI = 40 ms TrCH2: TTI = 20 ms TrCH3: TTI = 10 ms
Number of bits per normal frame	TrCH1: N bits TrCH2: M bits TrCH3: K bits
TGL	5 slots
TGP	>=4, meaning that there is only one transmission gap per 40 ms
Puncturing percentage:	is depicted by color in the figure.

ΔSIRi: required SIR target increase for TrCHi	The equation is following for ΔSIRi: ΔSIRi = ΔSIRi_coding + ΔSIRi_compression ΔSIRi_coding = coding gain degradation due to "too much" puncturing ΔSIRi_compression = 10 log $(F_i*15/(F_i*15-TGL_{Fi}))$ where F_i is the number of frames over which the puncturing is done. And TGL_{Fi} is the gap length in slots within those F frames. The only simulation result that is available is that with 33 % puncturing, ΔSIRi_coding = 1 dB. This is with Pedestrian A channel with convolutional coding, TTI=10 ms [1]. The other values for ΔSIRi_coding are based on following assumptions: The assumption which is used in this simple example is that with < 20 % puncturing ΔSIRi_coding = 0, however there is no simulation results available at the moment to show this. The other assumption is that that with 33 % puncturing, ΔSIRi_coding = 1 dB for all TTIs, even there are simulation results available only for TTI=10 ms. This leads to following figures used in the example. • 33 % puncturing : ΔSIRi= 1 dB + 1.7 dB = 2.7 dB • 17 % puncturing : ΔSIRi= 0 dB + 0.8 dB = 0.8 dB • 8 % puncturing : ΔSIRi= 0 dB + 0.4 dB = 0.4 dB • no puncturing : ΔSIRi= 0 dB + 0 dB = 0 dB The actual required SIR target increase for each frame is finally max(ΔSIR1, ΔSIR2, ΔSIR3), and is shown in the figure by highlighting the maximum value for each frame. NOTE: It is emphasized that this is really very simplified example, since it is not fully based on simulation results, but partly on some assumptions. However, the main point is that it is made for helping to understand the differences in the performance between puncturing per radio frame and puncturing per TTI. Hopefully it will serve the purpose.

Table 1. Parameters for the comparison example.

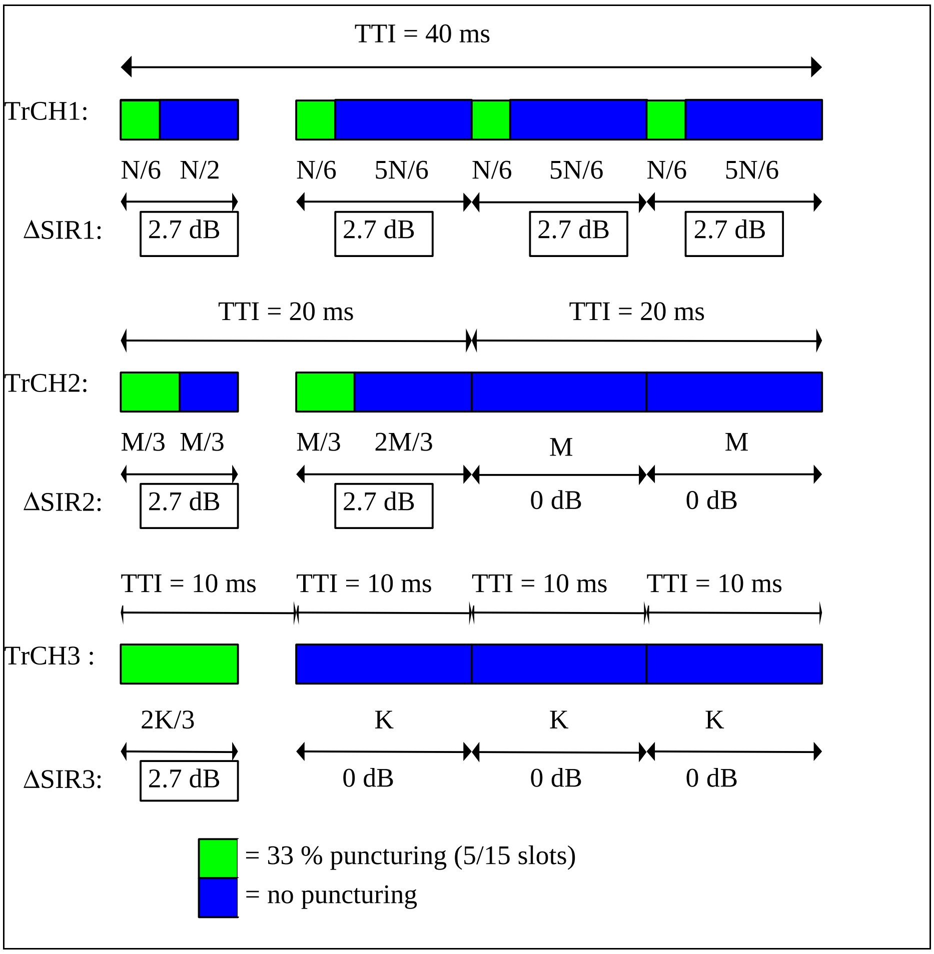

Figure 1. Puncturing done per radio frame basis. Shows how the bits are spread to different frames after 1st interleaving.

From figure 1 it can be seen that the required SIR target has to be 2.7 dB, or at least close to that, for the whole duration of TTImax=40 ms, if puncturing is done per radio frame basis. This is because 1st interleaving spreads the bits, which have 33 % puncturing, equally over the whole TTI. For each frame, the SIR target has to be set based on the bits having maximum puncturing. If the SIR target would not be increased also for the 30 ms after the gap, bit error rate of the bits having 33 % puncturing would be higher, which would then increase the frame error rate of the TrCH1. In order to ensure that the target frame error rate is reached for all TrCHs in the CCTrCH, the SIR target increase of about 2.7 dB is needed for the whole 40 ms.

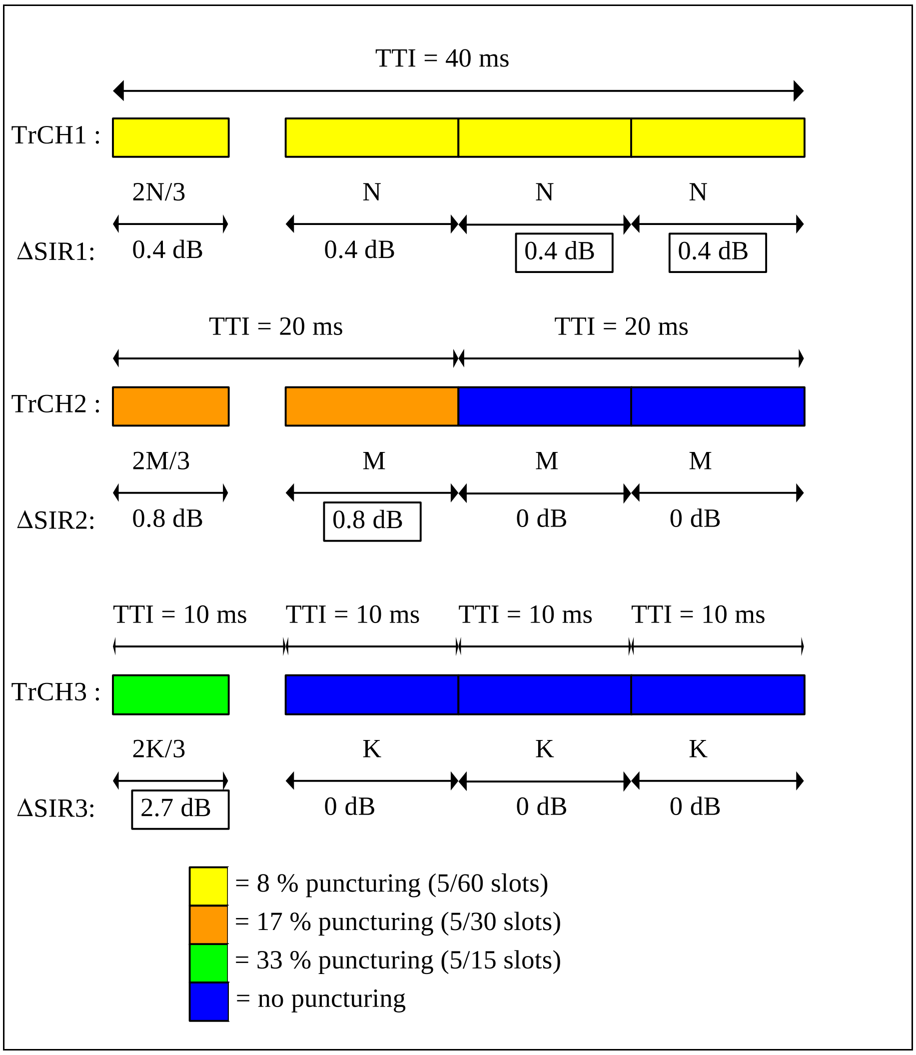

Figure 2. Puncturing done per TTI basis.

From figure 2 it can be seen that the required SIR target increase varies from frame to frame, if puncturing is done per TTI. The maximum SIR target increase is always defined by the TrCH having the smallest TTI, containing a transmission gap in that TTI. This is because TrCH having the smallest TTI has the biggest puncturing percentage. If this puncturing method is used, then there has to be as many DeltaSIR values for outer loop power control, Delta SIR_1…$DeltaSIR_n$ which network signals to UE, as there are different TTI lengths in the CCTrCH.

If we compare the performance of a) puncturing done per radio frame and b) puncturing done per TTI, it can be seen that method b) has better performance. In the example above,

Method a) has average SIR target increase : 2.7 dB over the max TTI of 40 ms.

Method b) has average SIR target increase : 1.2 dB over the max TTI of 40 ms.

Note1: If there would have been a transmission gap in every frame within the TTI of 40 ms, then the performance would have been the same for both methods. In that case the SIR target increase would have been 2.7 dB over the max TTI of 40 ms for both methods.

Note2: Even in that case, when there are several transmission gaps within the max TTI, with method b), only as many Delta SIRi values has to be signaled to UE, as there are different TTI lengths in the CCTrCH.

3. DeltaSIRi parameters for outer loop power control

At the present, TS 25.331 RRC protocol specification [3], contains parameter DeltaSIR, which is defined to be signaled to UE, together with other compressed mode parameters. DeltaSIR is defined to be : "Delta in DL SIR target value to be set in the UE during the compressed frames".

It was already shown in the previous section that puncturing method done per TTI has better performance, if as many DeltaSIR values are signaled to the UE , as there are different TTI lengths in the CCTrCH. Thus if an agreement can be reached that puncturing will be made per TTI basis, a liaison should be sent to WG2, to inform them that with compressed mode by puncturing a separate DeltaSIRi parameter should be signaled for each different TTIi length in the CCTrCH.

To further enlighten the subject of DeltaSIR parameter definition, one further issue related to this is tackled in the next subsection, 3.1; how to define DeltaSIRi parameter value if transmission gap crosses over TTI boundaries so that the gap length is not equal in the consecutive TTIs. This can happen in certain special cases.

After that, a proposal is made in section 3.2, what is the exact algorithm how the DeltaSIRi parameters should be used in outer loop power control.

3.1 DeltaSIRi definition when transmission gap crosses over TTI boundaries

If the transmission gap crosses over a frame boundary (double frame method), it means that the required SIR target increase might differ in different TTIs of the same TrCH. This is because the transmission gap may be positioned over the frame boundary in such a way, that the gap length in consecutive frames is not of the same size. And if these consecutive frames do not belong to the same TTI, it means that the puncturing percentage can differ in different TTIs for the same TTI length. In this case we should think whether it is sufficient that only one DeltaSIRi value can be signaled for each different TTI length, TTIi.

The maximum SIR target difference in different TTIs will happen in those cases where timing of the target cell is known. Since then there is a need to position the gap exactly so that the it matches to the target cell timing. These cases are:

- GSM FCCH/SCH tracking with prior timing information.
- TDD SCH tracking with prior timing information

For both of these cases gap length of 4…5 slots is probably used. This means that the maximum difference in the gap lengths in the consecutive frames with double frame method is such that frame i contains 4 slot gap and frame i+1 contains 1 slot gap => 3 slot difference. See the example in figure 3. The gap length of 5 slots is positioned so that 4 slots from the gap are in frame i and 1 slot is in frame i+1.

The required ΔSIR1, ΔSIR2 and ΔSIR3 are defined in the same way as in table 1, with additional assumption that 27 % puncturing means ΔSIRi_coding = 0.9 dB (pure assumption for example purposes, based on the fact that simulation result for 33 % puncturing gave ΔSIRi_coding = 1 dB). This leads into ΔSIRi =ΔSIRi_coding +ΔSIRi_compression =0.9 dB + 1.4 dB =2.3 dB. For all other puncturing ratios < 20 % it is again assumed that ΔSIRi_coding = 0dB and thus ΔSIRi =ΔSIRi_compression = 10 log (F_i*15/(F_i*15-TGL_{Fi})), where F_i is the number of frames over which the puncturing is done. And TGL_{Fi} is the gap length in slots within those F_i frames. Hopefully it is understood, that again, the main point is illustrate the problem with the figure, not to give the exact correct values.

Figure 3 shows that the optimum required SIR target increase pattern over the TTI=40ms is, using definition max(ΔSIR1, ΔSIR2, ΔSIR3) for each frame, as following:

0.6 dB, 2.3 dB, 0.3 dB, 0.4 dB

From this we can see that if we signal n different DeltaSIRi values for each different TTI length, it has to be only the value DeltaSIRi=ΔSIRi_coding which is signaled, from the equation:

ΔSIRi =ΔSIRi_coding +ΔSIRi_compression

ΔSIRi_compression is fully defined by F_i and TGL_{Fi}, and thus does not need to be signaled.

Let's compare these possibilities.

a) If DeltaSIRi=ΔSIRi_coding , then following values are signaled: DeltaSIR1=0, DeltaSIR2=0, DeltaSIR3=0.9 for the example in figure 3. With the help of these, and with F_i and TGL_{Fi} , UE can derive the following pattern with pattern max(ΔSIR1, ΔSIR2, ΔSIR3):

0.6 dB, 2.3 dB, 1.2 dB, 0.6 dB

which is almost the same as the optimal pattern.

b) If DeltaSIRi=ΔSIRi_coding +ΔSIRi_compression, this creates a problem, since in this case two different values should be signaled for each different TTI length to optimise the performance. Or, alternatively, only the worst case value is signaled for each TTI length. With the worst case values the following pattern would be obtained with max(ΔSIR1, ΔSIR2, ΔSIR3):

0.6 dB, 2.3 dB, 2.3 dB, 0.6 dB

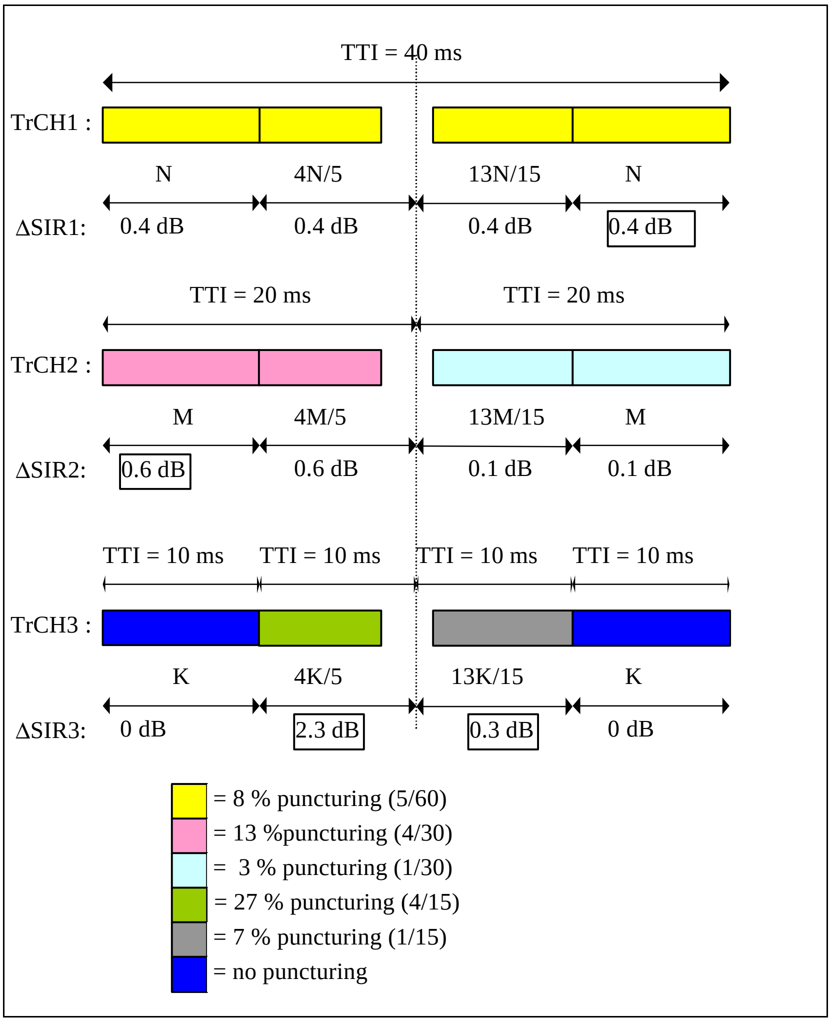

Figure 3. Puncturing done per TTI. Transmission gap is crossing over frame boundary.

Based on this it is proposed to use case a), where only one DeltaSIRi parameter value is signaled for each TTI length, but so that DeltaSIRi=ΔSIRi_coding.

Here, it should be remembered, that in the search patterns, which do not use prior timing information, the gap can (and should) always be positioned so that the gap length in consecutive frames differs only by max. 1 slot. In those cases the SIR target difference in consecutive TTIs of the same TrCH should be so negligible, that there shouldn't be any problems in using only one DeltaSIRi parameter for each different TTI length.

3.2 Algorithm for outer loop power control

Based on the previous section, the conclusionary proposal is that if there are n different TTI lengths in the CCTrCH, then n separate DeltaSIR values are signaled to the UE, DeltaSIRi, i=1…n, one for each TTI length. These n DeltaSIR values should then be used in the following way for the outer loop power control.

For each frame the offset of the SIR target compared to SIR target in normal mode, is :

$$\Delta\text{SIRframe}=\max(\Delta\text{SIRi}, \ldots, \Delta\text{SIRn}) \qquad (1)$$

where

$$\Delta\text{SIRi}= \Delta\text{SIRi\_compression} + \Delta\text{SIRi\_coding} \qquad (2)$$

If there is no transmission gap within the current TTIi ms for the TTI length of TTIi, then

$$\Delta\text{SIRi\_compression} = 0$$

$$\Delta\text{SIRi\_coding} = 0$$

If there is a transmission gap within the current TTIi ms for the TTI length of TTIi, then

$$\Delta\text{SIRi\_compression} = 10 \log (F_i*15/(F_i*15-TGL_{Fi})) \qquad (3)$$

$$\Delta\text{SIRi\_coding} = \text{DeltaSIRi} \qquad (4)$$

Here F_i is the number of frames in the TTI length of TTIi. And TGL_{Fi} is the gap length in slots (either from one gap, or a sum of several gaps) within those F_i frames.

4. Patterns for GSM FCCH/SCH search when timing not known

Table 2 below used to be in the annex of TS 25.215, defining suitable patterns for GSM FCCH/SCH search, when timing of the target cell is not known. Let's look at whether these patterns can be used with compressed mode with puncturing.

With puncturing method , the TGD and TGP parameters should be such that for the max TTI in the CCTrCH, there is either no transmission gap at all (0% puncturing) or fixed amount of puncturing (sum of gaps has always the same length within max TTI). In that way the parameters DeltaSIRi, signaled for each TTIi in the CCTrCH, work well throughout the whole pattern. Otherwise, the number of parameters would have to be increased.

This means following restrictions for TGD and TGP parameters (x mod y =0 means that x is divisible by y):

- **TGD:**

  with single-frame method any value is possible

  with double-frame method it has to be either TGD=0, TGD=2 or TGD mod 4=0

- **TGP: can be either TGP=2 or TGP>2;**

  If TGP>2 then

    if (TGD<4) then TGP has to fulfil: TGP mod 4 = 0

    if (TGD ≥4) then TGP has to fulfil: TGP mod 8 =0

Using this rule, it has been marked to the table below, which patterns suit for the compressed mode by puncturing.

	TGL	TGD	TGP	PD parallel search / serial search	Suitable with puncturing	Comment
Pattern 1	7	0	2	40/64	Yes	Suits with all max TTIs: 10,20,40 and 80 ms
Pattern 2	7	0	3	39/63	-	Does not work if max TTI > 10ms, since TGP mod 4 ≠ 0
Pattern 3	7	2	9	63/252	-	Does not work if max TTI > 10 ms, since TGP mod 4 ≠ 0
Pattern 4	7	3	12	99/123	-	Does not work if max TTI > 10ms, since TGD ≠ 0, TGD ≠ 2 or TGD mod 4 ≠ 0
Pattern 5	14	0	2	12/26	-	TGL too long
Pattern 6	14	2	6	24/48	-	TGL too long
Pattern 7	14	2	8	34/58	-	TGL too long
Pattern 8	14	2	12	60/84	-	TGL too long
Pattern 9	10	12	48	108/828	Yes	Suits with all max TTIs: 10, 20, 40 and 80 ms
Pattern 10	10	0	48	240/1440	Yes	Suits with all max TTIs: 10, 20, 40 and 80 ms

Table 2 .- List of compressed mode patterns used for initial GSM FCCH/SCH acquisition without timing information

The conclusion is that patterns 1, 9 and 10 suit for compressed mode with puncturing. Pattern1 could give faster acquisition, and patterns 9 and 10 can be used for slower acquisition.

It should be noted, that table 1 gives just an example what kind of patterns can be used. The patterns will not be specified. There can exist other good patterns, which will also suit to be used with compressed mode by puncturing, as long as the rule given above for parameter values TGP and TGD is used.

5. Patterns for FDD-FDD interfrequency handover, selection mode

Table 3 below used to be in the annex of TS 25.215, defining suitable patterns for FDD-FDD interfrequency handover.

	TGL	TGD	TGP1	TGP2	PD
Pattern1	7	24/15	4	20	M
Pattern2	7	24/15	4	140	M
Pattern3	7	2	4	Not Used	M
Pattern4	7	2	4	20	M
Pattern5	7	2	4	140	M
Pattern6	14	3	6	18	M
Pattern7	14	3	6	138	M

Table 3 .- List of compressed mode patterns used for FDD-FDD interfrequency handover , selection mode

There is a separate contribution from Nokia [2], where it is proposed that there can be two different length TGLs: TGL1 and TGL2 within TGD, in order to allow for capturing sufficient number of SCH symbols with CM by puncturing. It is also proposed in that paper, that values TGL1=10 and TGL2=5 are supported for FDD-FDD interfrequency handover.

Table 4 lists possible patterns used with compressed mode by puncturing. It can be seen that Patterns 3-5 are the same as in table 3. Patterns 8-10 are specially designed for compressed mode by puncturing, using the TGL1, TGL2 idea.

	TGL1	TGL2	TGD	TGP1	TGP2	PD
Pattern3	7	Not used	2	4	Not Used	M
Pattern4	7	Not used	2	4	20	M
Pattern5	7	Not used	2	4	140	M
Pattern8	10	5	25/15	4	Not Used	M
Pattern9	10	5	25/15	4	20	M
Pattern10	10	5	25/15	4	140	M

Table 4 .- List of compressed mode patterns used for FDD-FDD interfrequency handover with puncturing method , selection mode

With the FDD-FDD interfrequency handover patterns, the TGD and TGP parameters should be defined again in such way that there is the same amount of puncturing in each max TTI in the CCTrCh to minimise the number of DeltaSIR parameters to be signaled. This has been taken into account in table 4, as much as possible, by defining that TGP1mod 4=0 and TGP2mod4=0. This makes sure that the puncturing percentage is always fixed for TTI lengths of 40 ms and 80 ms.

For TTI=20 ms , there can be, however, two different puncturing percentage values: 10/30= 33 % or 5/30 = 17 %, since with TGL1=10, TGL2=5 method , TTI=20 ms sometimes contains 5 slot gap, sometimes 10 slot gap. This situation cannot be avoided, since the cell search patterns using the TGL1=10, TGL2=5 idea will always contain multiple of 3 compressed frames, and 3 frames is not a power of 2, like the TTI lengths are. See figure 4.

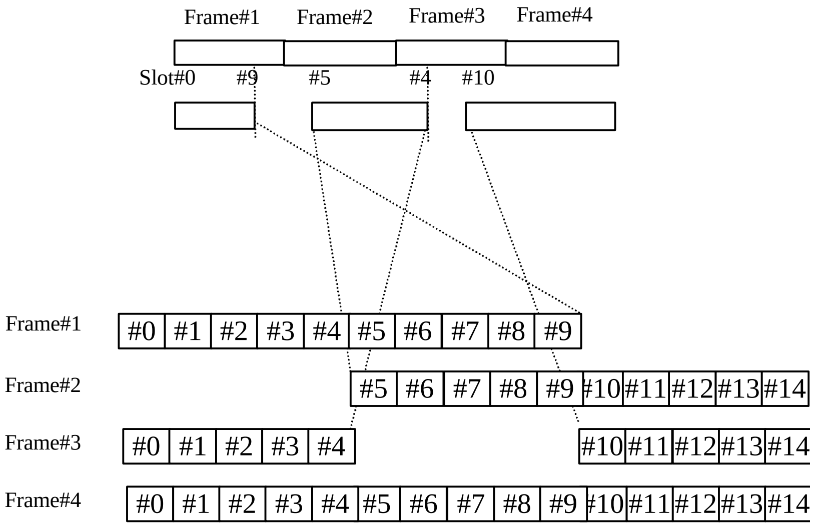

Figure 4. Cell search pattern with TGL1=10, TGL2=5, TGL=25/15 for FDD-FDD interfrequency handover.

The solution for this is that

a) if CCTrCH contains a TrCH with TTI=10 ms, then DeltaSIRi, signaled for TTI=20ms, should be defined for TGL2=5 slot gap (and not for TGL1=10 slot gap). Since when equation ΔSIRframe=max(ΔSIRi, …, ΔSIRn) is used at the UE, it means that it gives following pattern :

ΔSIR (10ms), ΔSIR (10ms), ΔSIR (10 ms), ΔSIR (20 ms)

2.7 dB , 2.7 dB , 2.7 dB , 0.8 dB

meaning, that TTI=10 ms dominates in 3 / 4 frames. And thus DeltaSIRi value for TTI=20 ms for TGL1=10 slots will never be used. Thus the SIR pattern will be correct if TGL2=5 is used: DeltaSIRi=0.8 dB for TTI=20 ms.

b) If there is not any TrCH with TTI=10 ms in the CCTrCH, then DeltaSIRi for TTI=20 ms should be defined for TGL1=10 slot gap. In this case the optimum SIR pattern would be :

ΔSIR (20ms), ΔSIR (20ms), ΔSIR (20 ms), ΔSIR (20 ms)

2.7 dB , 2.7 dB , 0.8 dB , 0.8 dB

but instead the resulting SIR pattern will be:

ΔSIR (20ms), ΔSIR (20ms), ΔSIR (20 ms), ΔSIR (20 ms)

2.7 dB , 2.7 dB , 1.8 dB , 1.8 dB

since DeltaSIR=ΔSIRi_coding =1 dB is signaled for TTI=20ms , and UE calculates that ΔSIRi= ΔSIRi_compression = 1.7 dB for first 20 ms, and ΔSIRi= ΔSIRi_compression = 0.8 dB for the last 20 ms. So this is not fully optimum, but we still think that it serves the purpose sufficiently. Of course, it could be defined that two separate DeltaSIR parameters are signaled for TTI=20 ms length in this case. However, we don't think it is absolutely necessary.

As a conclusion, the rules for the TGD and TGP for FDD-FDD interfrequency handover with compressed mode by puncturing are given below:

If TGL2 is not used, meaning TGL=TGL1=TGL2, then the same rule as with GSM FCCH/SCH search has to be used:

- **TGD:**

  with single-frame method any value is possible
  with double-frame method it has to be either TGD=0, TGD=2 or TGD mod 4=0

- **TGP: can be either TGP=2 or TGP>2;**

  If TGP>2 then

  if (TGD < 4) then TGP has to fulfil: TGP mod 4 = 0
  if (TGD ≥ 4) then TGP has to fulfil: TGP mod 8 =0

If TGL1=10 and TGL2=5, then

- **TGD: has to be TGD=k*15+(24…26)/15 where k =0 or 1**

- **TGP: has to fulfil: TGP mod 4 = 0**

where k selects whether the TGL2=5 slot gap is on the 3rd or 4th frame in the TGP.

6. Timing of the patterns and simultaneous patterns

6.1 Timing of the patterns

It has been pointed out already in sections 4 and 5 in this paper, that if compressed mode by puncturing is used, the compressed mode patterns should be designed so TGD and TGP parameter values are such that for the max TTI in the CCTrCH, there is either no transmission gap at all (0% puncturing) or fixed amount of puncturing (sum of gaps has always the same length within max TTI). Otherwise the DeltaSIRi (i for each TTI length) parameter design for the outerloop power control will be quite complicated.

Additional restriction related to this, of course, is that the compressed mode patterns, containing more than one gap, can start only at certain restricted time instants. The rule is given below:

The first transmission gap in the pattern can start only in radio frames with SFN fulfilling the relation

SFN mod $F_{max} = 0$

where F_{max} denotes the maximum number of radio frames within the transmission time intervals of all transport channels which are multiplexed into the same CCTrCH.

6.2 Simultaneous patterns

The patterns which use compressed mode by puncturing , have to occur in such way that within one max TTI interval in the CCTrCH, there are transmission gaps only from one pattern. Otherwise the DeltaSIR parameter design would be too complicated, since the puncturing percentages would vary in different max TTI intervals.

There can, however, be transmission gaps from other patterns, which use compressed mode by SF/2 method within the same max TTI interval as where pattern using puncturing method creates a gap. This is because in that case the total SIR target increase is easily calculated as the sum of ΔSIRframe values of these different patterns:

Total SIR target increase = ΔSIRframe (SF/2 method) + ΔSIRframe (puncturing) (2)

Where calculation of ΔSIRframe (puncturing) is defined in equations (1)-(4) in section 3.2 in this paper. And calculation of ΔSIRframe (SF/2 method) is defined in [3]. This will not change the SIR targets in the other frames during the max TTI, because this does not change the puncturing percentage there. So in the other frames during the max TTI, ΔSIR target (puncturing) is used.

Patterns using higher layer scheduling cannot have gaps in the same max TTI as where pattern using puncturing creates a gap. This is because these two methods use different equations e.g. in 1st DTX insertion, and it would complicate the usage of multiplexing diagram if both of the methods would be used in the same max TTI.

7. Conclusions

Following conclusions can be made based on this paper.

1) PUNCTURING METHOD

Puncturing done per TTI (and not per radio frame) has better performance, so that should be selected to the specifications. It is also less complex when looking at the changes in multiplexing sections in TS 25.212. **There is a separate CR to S25.212 giving the definitions for this in a separate contribution.**

2) DELTA SIR VALUES TO BE SIGNALED FOR COMPRESSED TTIs

If there are n different TTI lengths in the CCTrCH , then n different Delta SIRi values will be signaled to the UE, DeltaSIRi, i=1…n, one for each TTI length, to be used for the outer loop power control. The algorithm how these parameter values should be used is given in section 3.3. **The attached CR proposes to add these parameters to the list of compressed mode parameters in TS 25.215. Also a liaison statement should be sent to WG2 to inform them about the DeltaSIRi parameters and the outer loop algorithm. Both section 3.2 and 6.2 from this paper should be included to this liaison.**

3) PATTERNS FOR GSM FCCH/SCH SEARCH WHEN TIMING NOT KNOWN

With puncturing method , the TGD and TGP parameters should be such that for the max TTI in the CCTrCH, there is either no transmission gap at all (0% puncturing) or fixed amount of puncturing (sum of gaps has always the same length within max TTI). In that way the parameters DeltaSIRi, signaled for each TTIi in the CCTrCH, work well throughout the whole pattern. Otherwise, the signaling will become too complicated. **The attached CR proposes to add these restrictions to S25.215.**

4) PATTERNS FOR FDD-FDD INTERFREQUENCY HANDOVER

With the FDD-FDD interfrequency handover patterns the same kind of rules should be used for TGD and TGP as for GSM FCCH/SCH search, explained in point 3) above. The only difference is that now TGD can be also non-integer number of frames. **The attached CR proposes to add these restrictions to S25.215.**

5) STARTING TIME OF THE PATTERN

The first transmission gap in the pattern, containing more than one gap, can start only in radio frames with SFN fulfilling the relation

SFN mod F_{max} = 0

where F_{max} denotes the maximum number of radio frames within the transmission time intervals of all transport channels which are multiplexed into the same CCTrCH. **The attached CR proposes to add these restrictions to S25.215.**

6) SIMULTANEOUS PATTERNS

The patterns which use compressed mode by puncturing , have to occur in such a way that within the same max TTI interval in the CCTrCH, there are transmission gaps only from one such pattern. Otherwise the DeltaSIR parameter design would be too complicated.

Gaps from other patterns, using SF/2 method, can be scheduled within the same max TTI , as where pattern using puncturing creates a gap. Gaps from other patterns using higher layer scheduling, cannot be scheduled within the same max TTI as where pattern using puncturing creates a gap.

The attached CR proposes to add these restrictions to S25.215.

REFERENCES:

[1] TSGR1#9(99)j03, "Means for compressed mode by puncturing in downlink", source Nokia.

[2]TSGR1#10(00)0019, "FDD-FDD interfrequency handover with compressed mode by puncturing, source Nokia.

[3] 3GPP RAN TS 25.331: "RCC protocol specification".

3GPP TSG RAN WG1 Meeting #10
Beijing, China, Jan 18 – 21, 2000

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Category:	F	Correction	☐	**Release:**	Phase 2	☐
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with an X)	D	Editorial modification	☐		Release 99	X
					Release 00	☐

Reason for change:	There needs to be some parameterisation limitations for compressed mode by puncturing. Otherwise it is difficult to define the SIR target increase value for the compressed frames. The restrictions on the TGD and TGP parameter values are given for compressed mode by puncturing. The restrictions are also defined for the simultaneous patterns, if one of the patterns uses puncturing method. Further, it is defined that for compressed mode by puncturing, several DeltaSIR values are signaled, one value for each TTI length in the CCTrCH .
Clauses affected:	6.1.1.2.Parameterisation of the compressed mode

Other specs affected:	Other 3G core specifications	X	→ List of CRs:	CR 25.212 - xxx
	Other GSM core specifications	☐	→ List of CRs:	
	MS test specifications	☐	→ List of CRs:	
	BSS test specifications	☐	→ List of CRs:	
	O&M specifications	☐	→ List of CRs:	

Other comments:	

help.doc

<--------- double-click here for help and instructions on how to create a CR.

5.2.8 UTRAN GPS Timing of Cell Frames for LCS

Definition	The timing between cell j and GPS Time Of Week. $T_{UTRAN-GPSj}$ is defined as the time of occurrence of a specified UTRAN event according to GPS time. The specified UTRAN event is the beginning of a particular frame (identified through its SFN) in the first significant multipath of the cell j CPICH, where cell j is a cell within the active set.
Applicable for	Connected Intra, Connected Inter
Range/mapping	The resolution of $T_{UTRAN-GPSj}$ is 1µS. The range is from 0 to 6.04×10^{11} µS.

6 Measurements for UTRA FDD

6.1 UE measurements

6.1.1 Compressed mode

6.1.1.1 Use of compressed mode/dual receiver for monitoring

A UE shall, on upper layers commands, monitor cells on other frequencies (FDD, TDD, GSM). To allow the UE to perform measurements, upper layers shall command that the UE enters in compressed mode, depending on the UE capabilities.

In case of compressed mode decision, UTRAN shall communicate to the UE the parameters of the compressed mode, described in reference [2], 25.212.

A UE with a single receiver shall support downlink compressed mode.

Every UE shall support uplink compressed mode, when monitoring frequencies which are close to the uplink transmission frequency (i.e. frequencies in the TDD or GSM 1800/1900 bands).

All fixed-duplex UE shall support both downlink and uplink compressed mode to allow inter-frequency handover within FDD and inter-mode handover from FDD to TDD.

< WG1's note : the use of uplink compressed mode for single receiver UE when monitoring frequencies outside TDD and GSM 1800/1900 bands is for further study >

UE with dual receivers can perform independent measurements, with the use of a "monitoring branch" receiver, that can operate independently from the UTRA FDD receiver branch. Such UE do not need to support downlink compressed mode.

The UE shall support one single measurement purpose within one compressed mode transmission gap. The measurement purpose of the gap is signalled by upper layers.

The following section provides rules to parametrise the compressed mode.

6.1.1.2 Parameterisation of the compressed mode

In response to a request from upper layers, the UTRAN shall signal to the UE the compressed mode parameters.

The following parameters characterize a transmission gap :
- TGL : Transmission Gap Length is the duration of no transmission, expressed in number of slots.
- SFN : The system frame number when the transmission gap starts

- SN : The slot number when the transmission gap starts

With this definition, it is possible to have a flexible position of the transmission gap in the frame, as defined in [2].

The following parameters characterize a compressed mode pattern :

- TGP : Transmission Gap Period is the period of repetition of a set of consecutive frames containing up to 2 transmission gaps (*).
- TGL : As defined above
- TGD : Transmission Gap Distance is the duration of transmission between two consecutive transmission gaps within a transmission gap period, expressed in number of frames. In case there is only one transmission gap in the transmission gap period, this parameter shall be set to zero.
- PD: Pattern duration is the total time of all TGPs expressed in number of frames.
- SFN : The system frame number when the first transmission gap starts

- UL/DL compressed mode selection: This parameter specifies whether compressed mode is used in UL only, DL only or both UL and DL.

- Compressed mode method: The method for generating the downlink compressed mode gap can be puncturing, reducing the spreading factor or upper layer scheduling and is described in [2].

- Transmit gap position mode: The gap position can be fixed or adjustable. This is defined in [2].

- Downlink frame type: This parameter defines if frame structure type 'A' or 'B' shall be used in downlink compressed mode. This is defined in [2].

- Scrambling code change: This parameter indicates whether the alternative scrambling code is used for compressed mode method 'SF/2'. Alternative scrambling codes are described in [3].

- PCM: Power Control Mode specifies the uplink power control algorithm applied during recovery period after each transmission gap in compressed mode. PCM can take 2 values (0 or 1). The different power control modes are described in [4].

- PRM: Power Resume Mode selects the uplink power control method to calculate the initial transmit power after the gap. PRM can take two values (0 or 1) and is described in [4].

- DeltaSIR: Delta in downlink SIR target during the compressed frame. With compressed mode by puncturing a separate value DeltaSIRi is defined for each different TTI length, TTIi, in the CCTrCH.

In a compressed mode pattern, the first transmission gap starts in the first frame of the pattern. The gaps have a fixed position in the frames, and start in the slot position defined in [2].

(*) : Optionally, the set of parameters may contain 2 values TGP1 and TGP2, where TGP1 is used for the 1st and the consecutive odd gap periods and TGP2 is used for the even ones. Note if TGP1=TGP2 this is equivalent to using only one TGP value.

In all cases, upper layers has control of individual UE parameters. The repetition of any pattern can be stopped on upper layers command.

The UE shall support [8] simultaneous compressed mode patterns which can be used for different measurements. ~~Upper~~ Higher layers will ensure that the compressed mode gaps do not overlap and are not scheduled within the same frame. Patterns causing an overlap or too long gaps will not be processed by the UE and interpreted as a faulty message.

If several simultaneous patterns will use compressed mode method by puncturing, higher layers will ensure that compressed mode gaps from these different patterns are not scheduled within the same time interval, i.e. having equal k value for $SFN+(k-1)*F_{max}$…$SFN+k*F_{max}-1$, where F_{max} denotes the maximum number of radio frames and k is integer, k>0.

Higher layers will also ensure that transmission gaps from different patterns can be scheduled within the same time interval, i.e. having equal k value for $SFN+(k-1)*F_{max}$…$SFN+k*F_{max}-1$, only if at maximum one of the patterns uses compressed mode method by puncturing and the other patterns use SF/2 method.

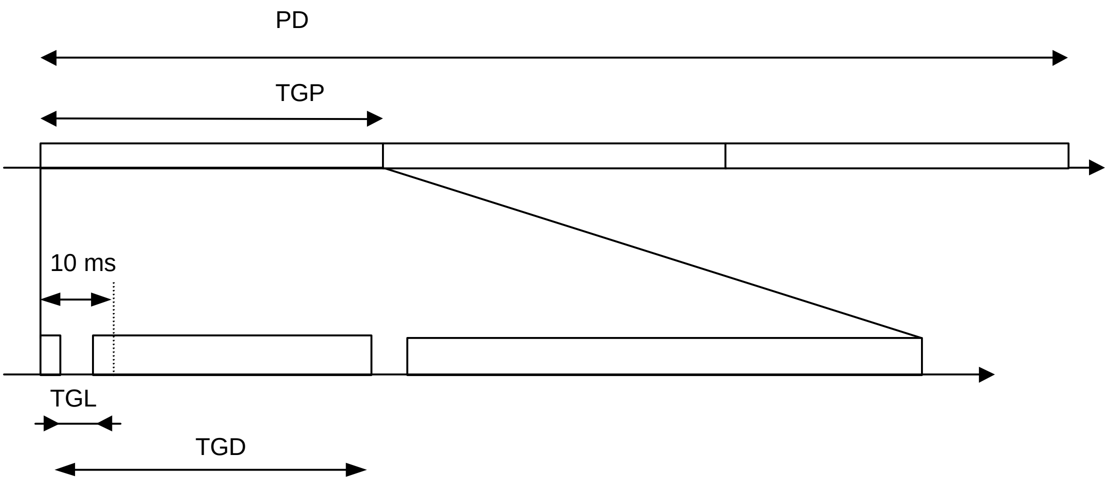

Figure 1 : illustration of compressed mode pattern parameters

6.1.1.3 Parameterisation limitations

In the table below the supported values for the TGL parameter is shown.

Measurements performed on	Supported TGL values
FDD inter-frequency cell	7, 14
TDD cell	4
GSM cell	3, 4, 7, 10, 14

Multi-mode terminals shall support the union of TGL values for the supported modes.

With compressed mode method by puncturing, there are following restrictions for patterns containing more than one transmission gap:

1) restrictions for SFN:

The first transmission gap in the pattern can start only in radio frames with SFN fulfilling the relation

SFN mod F_{max} = 0

where F_{max} denotes the maximum number of radio frames within the transmission time intervals of all transport channels which are multiplexed into the same CCTrCH.

2) restrictions for TGD and TGP:

If TGL1=TGL2, then

- TGD:

  with single-frame method any value is possible

  with double-frame method it has to be either TGD=0, TGD=2 or TGD mod 4=0

- TGP: can be either TGP=2 or TGP>2;

  If TGP>2 then

if ($TGD < 4$) then TGP has to fulfil: TGP mod 4 = 0

if ($TGD \geq 4$) then TGP has to fulfil: TGP mod 8 =0

If TGL1=10 and TGL2=5, then

- TGD: has to be TGD=k*15+(24…26)/15 where k =0 or 1
- TGP: has to fulfil: TGP mod 4 = 0

Further limitations on transmission gap position is given in TS 25.212.